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ABSTRACT

This paper explores the often elusive yet very important relationship between architectural design and educational reform. A review of the major findings from the educational and architectural research literatures on the impacts of school design on educational program effectiveness is presented. Commonalities among the disciplines were identified to create 27 design patterns. Seven sample patterns are described: (1) small schools; (2) the school as community center/necklace of community activities; (3) team suites/clusters of classrooms; (4) supervisable circulation paths; (5) small classrooms; (6) portfolio process studio; and (7) cluster of teacher offices. A table shows the origins and ranking of all 27 patterns. The development and use of design patterns should be seen as a collaborative dialogue between researchers and practitioners from both the architectural and educational professions. In addition, there is a need for a process view of the implementation of these reforms. (LMI)

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Design Patterns for American Schools:

Responding to the Reform Movement[1]

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[1] An earlier and longer version of this paper was presented as a keynote address at the Prairie School National Conference on Architecture and Education, Prairie School and Wingspread Conference Center, Racine, Wisconsin, May 16, 1992. Gary T. Moore, Ph.D., is Professor of Architecture and principal of Gary T. Moore & Associates, Consultants. Jeffery A. Lackney, M.Arch., is an architect currently pursuing a Ph.D. in environment-behavior studies in architecture. Our thanks to the School of Architecture and Urban Planning at the University of Wisconsin-Milwaukee for co-sponsoring the conference, and to Henry Halstead and the Conference Planning Committee, for their support. Address for the full paper including bibliography: Center for Architecture and Urban Planning Research, University of Wisconsin-Milwaukee, Milwaukee, WI 53201-0413.

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Design Patterns for American Schools:

Responding to the Reform Movement

This paper explores the often elusive yet critically important relationship between architectural design and educational reform. A review of the major findings from the educational and architectural research literatures on the impacts of school design on educational program effectiveness is presented. These findings will then be translated into a set of design principles or *patterns* which respond to the available research literature and to aspects of the current American school reform movement.

The study, of which this paper is a summary, consisted of several investigative stages.

First, the approach to this and previous work,[1] has been to review empirical literature identifying reliable findings about the impacts of the designed environment on educational performance (e.g., teacher attitudes, student attitudes and behavior, and student achievement). The educational and environment-behavior (EB) research literatures have over the years dealt with the concerns of the physical environment and its relationship to educational program effectiveness.

An excellent review of the research on the physical environment of the schools was by Carol Weinstein in the 1979 *Review of Educational Research.* Only part of what Weinstein concluded in 1979, however, is still true: "When classrooms varying in terms of furniture arrangement, aesthetic appeal, and the presence or absence of windows are

compared, differences in achievement are nonsignificant.... On the other hand, there is considerable evidence that the classroom environment can affect *nonachievement* behaviors and attitudes" (her emphasis, meaning secondary measures of student and teacher attitudes and behavior, like decreased social interaction or increased aggression). While there is still strong evidence for the effects of school buildings on nonachievement behaviors and attitudes, there is newer and what we would call incontrovertible evidence that at least four critical architectural variables directly and indirectly effect educational achievement.[2] Several areas of research continue to be productive, such as the impacts of classroom size and overall school size on performance (e.g., the Tennessee STAR study), while new research has emerged on the importance of the spatial definition of activity spaces. But there are a myriad of other topics and issues dealing with the physical environment of the school which are not being addressed by the educational or EB literatures.

Second, the architectural literature was reviewed and analyzed, looking at a range of educational facilities. A wide variety of formal architectural designs and ideas emerged, which have been tried over and over again in different locations, and seem to have passed the test of time. A total of 100 school buildings from the US, Canada, England, and elsewhere in Europe were included in the analysis. These were the best examples of award-winning school designs in the 1980s and early 1990s. This type of analysis could be construed as subjective and biased by prevailing trends. However, the experience of design inquiry by successful architectural practitioners should not be so quickly dismissed. From the collective experience gained by designing educational facilities, architects and school

administrators have found that certain architectural design patterns work better educationally than others.

Numerous school buildings have been published in the architectural press, but with infrequent critical commentary. Many buildings appear to exhibit friendly and non-institutional designs. For instance, the massing has been broken down into residential building--scaled forms, with sloped roofs, open and operable windows, and intimate spaces inside. In some cases, corridors have become indoor "streets" for incidental socializing and unstructured teaching. But the commentaries in the architectural press, where they exist at all, address only the uniqueness of the design of these schools, and whether the design evokes picturesque or excessively post-modern images (such as polychromatic brickwork, intricate stucco details, bell and clock towers, etc.), not whether they lead to better teaching/learning environments for the users nor whether they have any impact on educational performance.[3] In addition, there has been no empirical literature on the myriad of other design decisions which a responsible architect has to make in the course of designing, renovating, or expanding a school building.

Third, the educational reform literature was reviewed and analyzed for possible implications to the design of educational facilities. Questions raised by this analysis included: How will shared decision-making impact facility layout of classrooms or whole school buildings? What is the implication of new forms of assessment, such as portfolios, on the use of classroom space? How will the process of furthering the professionalization

of the teaching profession impact the privacy needs of teachers? The relationship between school design and educational reform is only beginning to be addressed. Several patterns identified here are based on the ground-breaking work of the California Department of Education in their 1990 publication *Schools for the Twenty-first Century,* and the work of the Architectural League of New York and their 1992 publication *New Schools for New York: Plans and Precedents for Small Schools.*

Fourth, communalities between these three literatures were examined by asking the questions: Were findings from the empirical literature reflected in any of the recent design trends? Is there empirical support for some of the educational reform ideas? It was found that, on whole, none of the architectural publications made any reference to scientific findings and none of the empirical studies cited particular buildings. Few of the architectural presentations referred to any type of assessment of facilities (with the exception of the British *Architect's Journal* and *Architectural Review).* However, some communalities were noted. For example, the findings on the limitations of open plan schools and the research reported from our own labs on "modified open plan schools" is directly related to the architectural trend toward suites of classrooms and the pod school.

Fifth, following this process, a set of the 27 design patterns were inductively created from the analysis of communalities in the literatures. The following design patterns all respond to current American educational reform, while several are, in addition, supported by empirical research and have been found to contribute to educational achievement. In

the interest of space, we will present only seven sample patterns: (1) And the Winning School is ... Smaller, (2) School as a Community Center/Necklace of Community Activities, (3) Team Suites/Clusters of Classrooms, (4) Supervisable Circulation Paths, (5) Small Classrooms, (6) Portfolio Process Studio, and (7) Cluster of Teacher Offices.

1. And the Winning School is ... Smaller

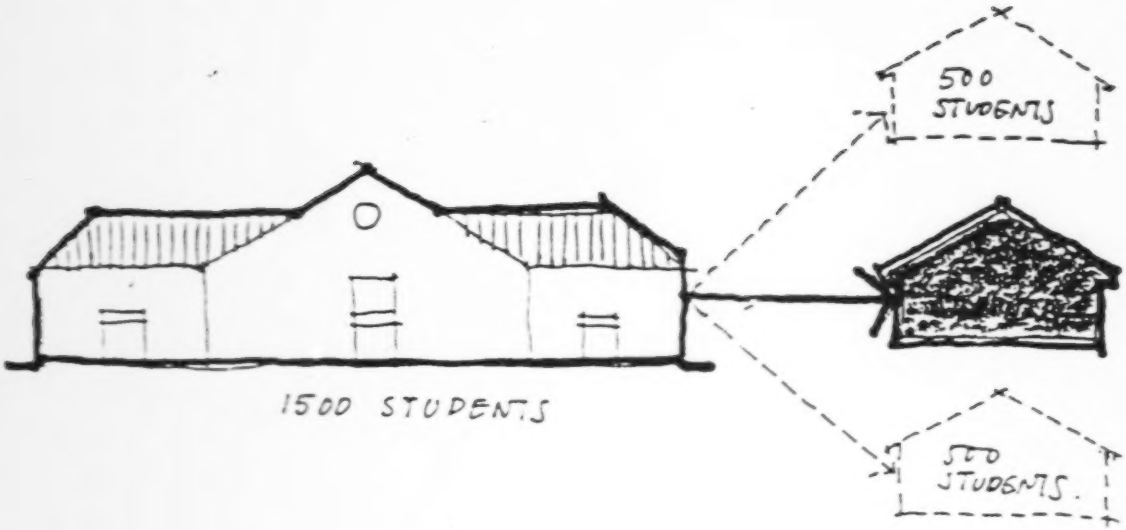
In addressing the issue of optimal overall size of school buildings, the Public Education Association has recently recommended downsizing schools to 500 to 600 pupils per school based on the argument that smaller schools will lead to a more humane educational system. But what is the evidence? Between the early 1960s and 1980, 344 articles were published pertaining to the effects of school size on academic achievement and other achievement-related variables. Prior to the '60s, many educators and policy makers held that increasing the size of schools was an important reform idea. This led to comprehensive schools in Great Britain and regional schools in the US. Larger schools were more cost-effective and believed to be more educationally efficient. In the now-classic *Big School, Small School*, the ecological/environmental psychologists Roger Barker and Paul Gump conducted a study of a sample of very big (over 2,000 students) and very small (100-150 student) high schools in Kansas. They concluded that small schools offered students greater opportunities to participate in extracurricular activities and to exercise leadership roles. In particular, participation in school activities, student satisfaction, number of classes taken, community employment, and participation in social organizations were all superior

in small schools relative to large schools. A review of some of the subsequent studies appeared in an article in the 1980 *Journal of Youth and Adolescence.* Small schools (those on the order of 500 students) also have lower incidence of crime levels and less serious student misconduct. Larger schools (e.g., 1,000 and larger) discourage a sense of responsibility and meaningful participation, particularly among students who have academic difficulty and come from lower socio-economic backgrounds.

William Fowler, writing in April 1992 from the US Department of Education, stated that the effects of school size at the elementary school level seems conclusive based upon "the number of students and general agreement of the findings." Fowler summarized the literature by reporting that (a) there is a negative relationship between math and verbal ability tests and elementary school size, (b) larger elementary schools are detrimental to student achievement, (c) smaller elementary schools are particularly beneficial to African-American students' achievement, and (d) the negative relationship between school size and school performance is most prevalent in urban schools.

As Paul Goldberger's review of the design competition on *New Schools for New York* concluded, "Educators have begun to suggest that the real sin in contemporary school design is size" (*New York Times,* May 27, 1990) -- "the winning school is -- smaller."

-o0o- Insert Figure 1 about here -o0o-



AND THE WINNING SCHOOL IS..
SMALLER

2. School as a Community Center/Necklace of Community Activities

Though no empirical research on the topic was found, a number of commentators have suggested that one of the important new educational directions for the 21st century school is integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and making the school a community hub.

Ted Fiske, in his recent book, *Smart Schools, Smart Kids,* points out a number of innovative "learning communities," turning schools into centers for child advocacy including some 70 community organizations dealing with health, social services, recreation, and housing.

Several new schools and ones on the drawing boards for New York City have taken this position. The *American School Board Journal* of May 1990 reported that the construction of community recreation centers as part of schools has been found to be a solution for building community support for public education among a growing number of community residents who do not have children of their own in school. Centers are scheduled so everyone in the community can use them, such as an adult education program, or a senior citizen group. New schools now include child care centers, the best examples being in Ontario, Canada. Other examples of including continuing and job training

educational programs, youth programs, programs for parents and families, administration offices, social services, and facilities for community and town hall meetings abound.

Architecturally, the school may wrap around the community functions, as around a "town square," or the community functions may be a "necklace" around the school. One example is the Lago Lindo School in Edmonton (*Canadian Architect*, 1991), in which a simple urban piazza connects the school to a future community building, creating a focal point for the community. This community relationship encourages the use of the school year round, both for primary education and for community functions. This pattern is in response to a wish for a broadening and deepening sense of community -- to the school as a life-long learning community.

-o0o- Insert Figure 2 about here -o0o-

3. Team Suites/Clusters of Classrooms

A common educational reform trend is the classroom suite, sometimes called the "Self-Contained Classroom Community" or "The Pod School." The philosophy behind this reform idea and design prototype is that teachers and students together constitute a small community. Variations on this theme include cooperative learning, new versions of team teaching, Ted Sizer's notion of teachers as team coaches, and the school as a mirror of the emerging workplace. In one interpretation of this philosophy, the Koln-Holweide model,

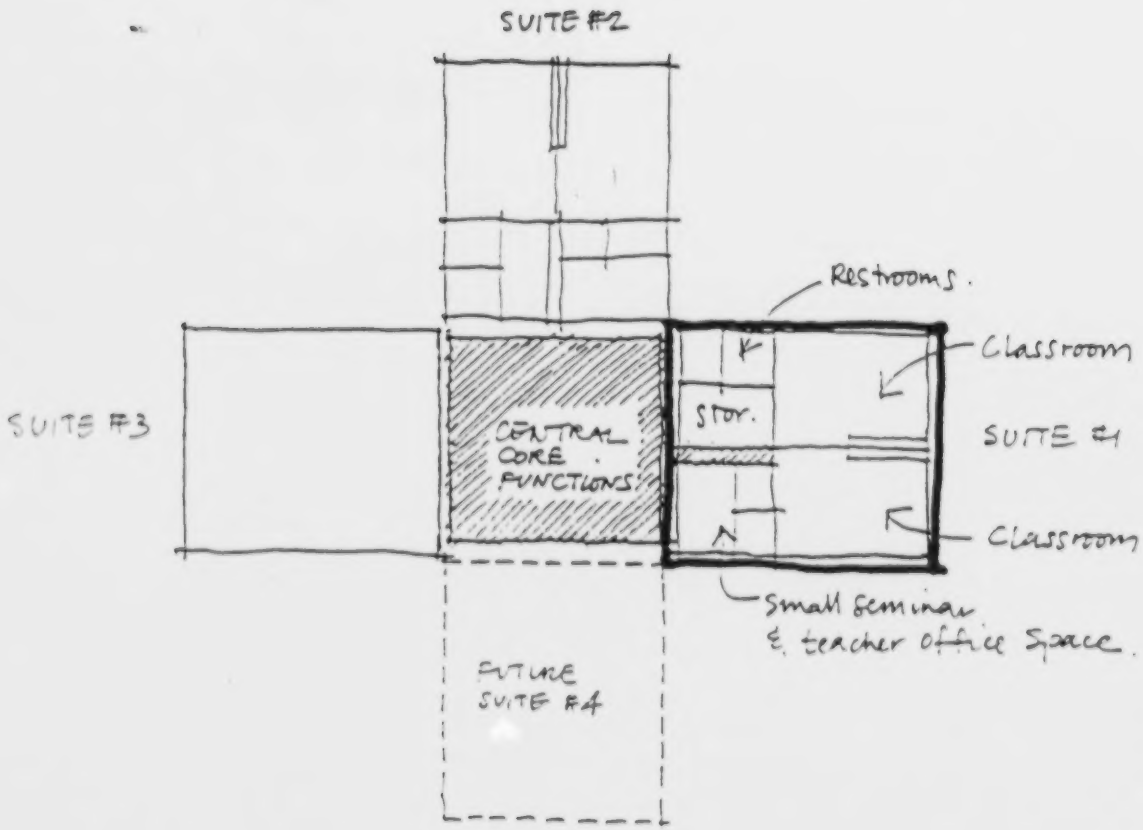
SCHOOL AS 'COMMUNITY CENTER'.
OR
'NECKLACE OF COMMUNITY ACTIVITIES'

teachers are divided into small, relatively autonomous teams (6 to 8 teachers), with each team being responsible for one group of students. The teams stay with their students from the fifth grade until the tenth grade.

The architectural response is to create a series of small suites of classrooms and support facilities around the central core functions. Among the support facilities may be lounges, informal learning spaces, a small computer hub, office space for teachers, lockers private bathrooms, display cases and small seminar rooms. Layouts can accommodate different teams and community philosophies: classrooms can vary according to size and openness, the relationship of the teachers' offices to classroom space can vary, etc.

Strickland & Carson Associates' design for School Site Number 1 in the Bronx, reported in New Schools for New York in the Winter 1990 *Teachers College Record*, included suites for an inner-city school each with classrooms, lounge space, office space for teachers, lockers, private bathrooms, window seats, terraces, hallway display cases, and smaller seminar rooms. The philosophy behind the design prototype, and this pattern, is that teachers and students together constitute a small community, or a "family" in a "house."

-o0o- Insert Figure 3 about here -o0o-



TEAM CLUSTERS / SUITES OF CLASSROOMS

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4. Supervisable Circulation Paths

Ambiguous circulation patterns impede children's use of schools and create unnecessary chaos and disorganization. The central educational issue with regard to circulation is "substance" time versus "non-substance," "transitional," or "preparatory" time. Studies by Paul Gump in 1975 found that more non-substance time is spent by children in open-plan schools than in closed-plan schools, with much of this being transit time between activities. Various design researchers (e.g., Fred Osmon, Anne Taylor, and our own work) have suggested that circulation patterns surrounding activities may encourage children to look around and see what is available, that fluid traffic patterns provide a means for better communication. Studies conducted in our own labs have found more teacher-teacher communication and a wider variety of interaction among students and between students and learning materials in early childhood education centers when circulation was clear and not disruptive of activities.

Supervisability, however, is a major problem for teachers and administrators in Milwaukee's inner city schools, as it is in most other major city school systems, and must be addressed in some fashion. There is a desire by educators to provide circulation corridors which provide passing opportunities for learning through the use of activity pockets for free-standing display cases, wall-mounted tack-boards, and pockets off the main corridor which contain vision glass into a specialty classroom. Corridors have been traditionally a convenient location for lockers. Architects often recess classroom entrances and stagger

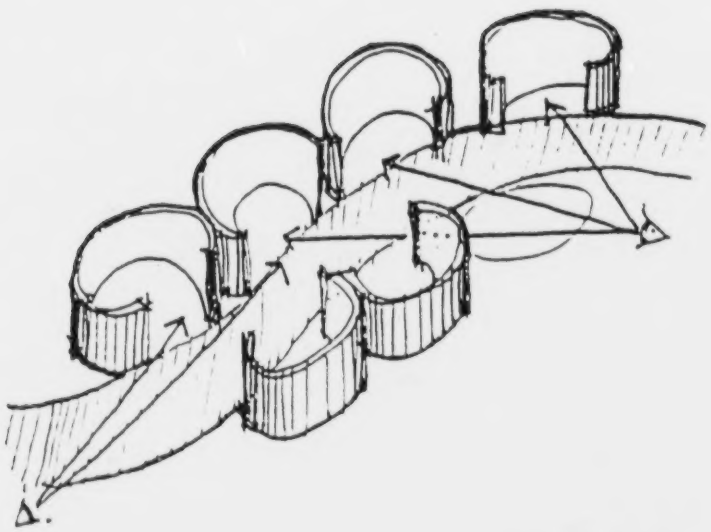
corridors to cut down on the excessive corridor lengths. However, in certain settings, the need for supervision and frequent occurrence of vandalism override the desire for circulation which responds solely to educational or functional needs. Children, in these circumstances, can hide in various nooks and crannies located off the corridor out of the sight of teachers or safety supervisors.

When possible, therefore, the circulation path should be cleared of visually obstructing objects to facilitate effective supervision. Clear circulation takes on a different meaning when supervisability is taken into consideration in the planning of a facility.

-o0o- Insert Figure 4 about here -o0o-

5. Small Classrooms

Any review of the considerable research on classroom size leads to an unmistakable conclusion -- that smaller is better. William Fowler at the Department of Education's Office of Educational Research and Improvement, recently summarizing the literature on class size, concluding that student attitudes, achievement, and voluntary participation all increase in smaller relative to larger classrooms. These findings suggest that in classrooms with less students, teachers can have more interactions with each student, can provide a rich and vastly differing array of interactions, can establish learning centers, student learning teams,



SUPERVISABLE CIRCULATION PATHS

peer tutors, and other instructional strategies, and overall can improve the quality of interactions with each student.

Research on density and crowding in classrooms leads to the conclusion that smaller is better as well. Higher absolute density and greater perceived crowding have been found to be associated with decreased attention, lower task performance, some behavioral problems like increased aggressive behavior, and social withdrawal. As Carol Weinstein noted, "Nowhere else are large groups of individuals packed so closely together for so many hours, yet expected to perform at peak efficiency on different learning tasks and to interact harmoniously" (1979, p. 585).

In a recent study, Project STAR, a four-year study in Tennessee which followed 6,500 students from kindergarten through third grade, reported that children in smaller classes (13-17 per room) outperformed those in regular-sized classes (22-25 per room) as measured by achievement test scores. In the early grades, children in smaller classes outperformed children from regular class sizes in all subjects, but especially in reading and mathematics test scores. Smaller classes were especially helpful for children in inner-city schools. And while the improvement was immediately clear in small kindergarten rooms, the benefits increased in first grade and remained stable over second and third grades.

The relationship between achievement and small-sized classrooms is only beginning to be understood. Glass and associates conducted a meta-analysis on a collection of studies

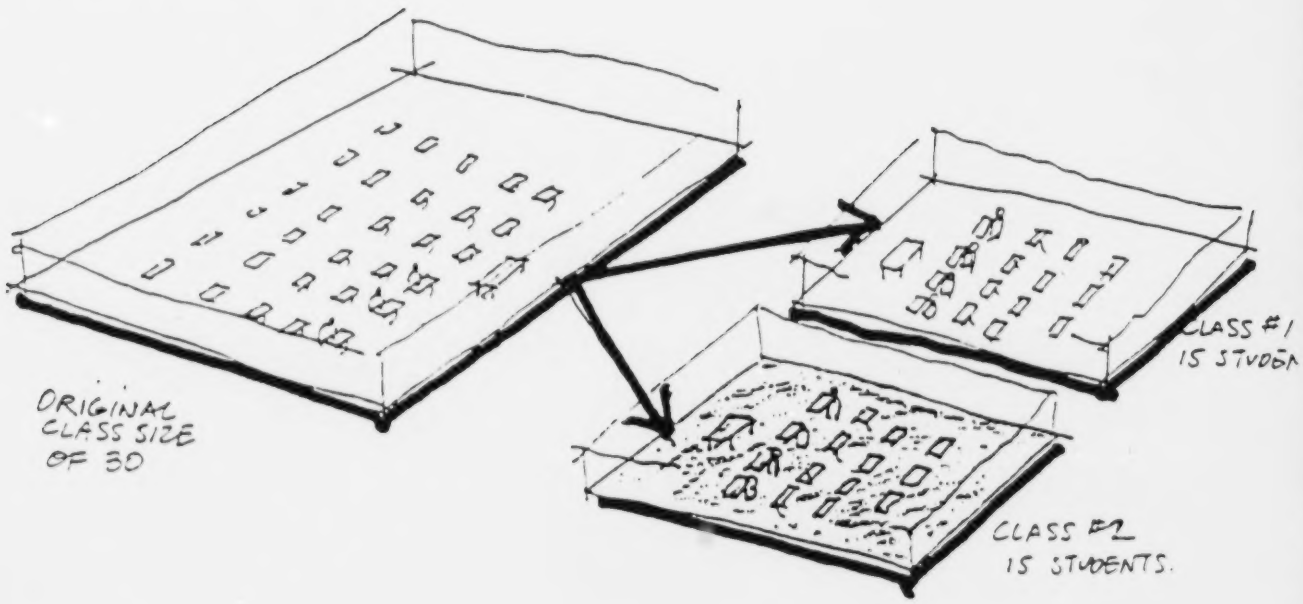
on class size in 1982 in School Class Size: Research and Policy. The analysis indicated that reducing class size from 30 to 20 can yield a gain of 6 percentage points on achievement scores, whereas a reduction from 20 to 10 students per classroom yields an additional 13 percentage points in achievement. Glass concluded that reductions in class size begin to make substantial differences in learning achievement around 15 students to a class.

-o0o- Insert Figure 5 about here -o0o-

6. Portfolio Process Studio

As schools move beyond traditional assessment strategies and standardized achievement tests, alternative assessment models such as "portfolios" (advocated by such reformers as Grant Wiggins and Holly Houston of the Center on Learning, Assessment, and School Structure, and Ted Sizer of the Coalition for Essential Schools) may become commonplace. Portfolios, it is argued, are means to more authentic testing of process as well as final product of student work, of what a student has actually learned, and a test more aligned with real-world situations.

The design implications for alternative forms of assessment, such as portfolios, has not been sufficiently addressed. The architectural design pattern which arises out of the notion of portfolio is the need to provide appropriate space for working on, storing, and exhibiting student portfolios. This space must accommodate a wide range of activities,



SMALL CLASSROOMS

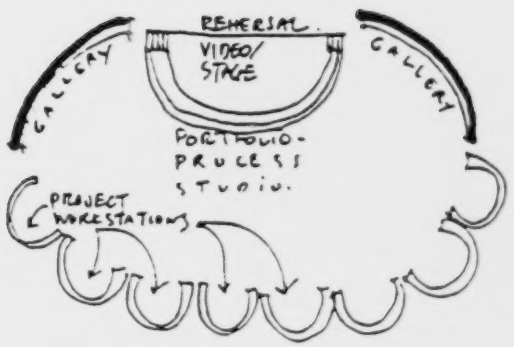
including but not limited to A/V studio productions, dance and other similar types of live performances, individual project work space, large open project tables, a gallery to display work, and staging areas.

-o0o- Insert Figure 6 about here -o0o-

7. Cluster of Teacher Offices

The need for a new professionalism among teachers has been recognized among educational reformers. The Carnegie Foundation for the Advancement of Teaching in "The Condition of Teaching, 1990," found that the nation's teachers "see themselves less involved in key school decisions, find working conditions unsatisfactory, and give the reform movement itself low marks." Ernest Boyer, president of the foundation concluded that "improved working conditions are essential if we hope to attract and hold outstanding teachers. They must be regarded as professionals, treated as professionals, and consider themselves to be professionals. Unless we create an environment in the schools...that sustains such an attitude, we cannot expect improvements to occur."

If teachers should be involved not only in direct classroom teaching, but in selecting textbooks and other aspects of shared decision making, then quality, private working space (which includes telephones, fax machines, computer terminals, etc.) must be provided.



PORTFOLIO
PROCESS STUDIO

-o0o- Insert Figure 7 about here -o0o-

Conclusions

The design patterns presented in this chapter are part of a larger list of some two-dozen patterns which have potential use in the design of new school facilities and the renovation or expansion of existing schools. They are among other we have been able to generate which respond directly to the ideas and concepts of the education reform literature. The table below presents the origins and status of all 27 patterns which have been generated to date. Patterns referred to in this chapter have been highlighted. The table identifies the origin of each pattern by referencing the disciplinary sources which are the basis for the pattern, or which have used, researched, or referred to it in some way (the architectural literature, educational reform movement, EB research, or practical experience of educators). Each pattern is a working hypotheses, subject to test and refutation or corroboration. The table reports overall confidence ratings in the validity of each pattern based on the strength of its current support in the EB literature, educator's experience, etc. for use by educators and architectural professionals.

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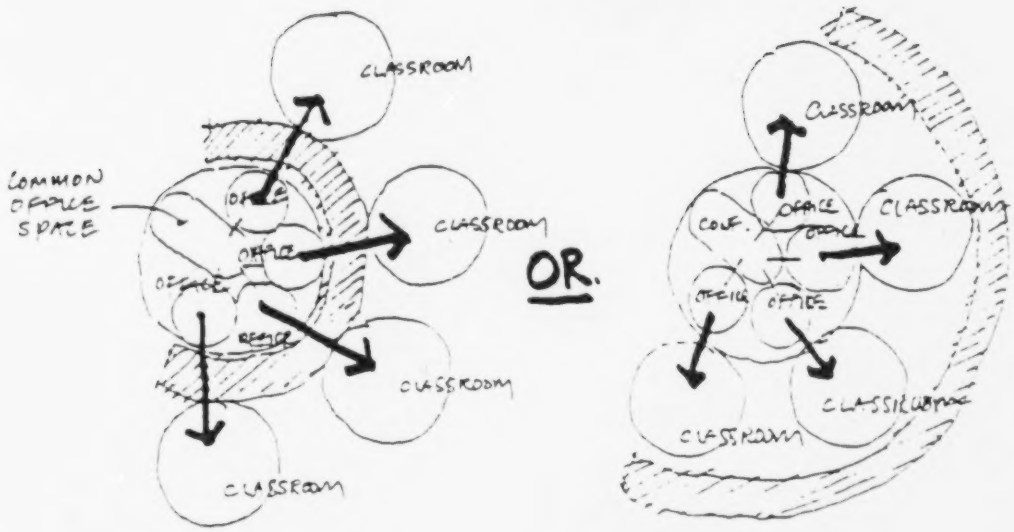
The development and use of design patterns should be seen as a collaborative dialogue between researchers and practitioners from both the architectural and educational



CLUSTER OF TEACHER OFFICES

Planning Issues	Justification: Architectural Literature	Justification: Educational Reform	Justification: F/B Research	Justification: Practical Experience	Status: Confidence Rating
And the Winning School is...Smaller	○	●	●	●	***
School as a Community Center/ Necklace of Community Activities	◒	●	○	○	**
Contextual Compatability	◒	○	○	○	*
Safe Location	○	○	◒	○	**

Building Organizing Principles					
Campus-Plan Concept/ Schools within Schools	◒	◒	◒	○	**
Compact Building Form	●	○	○	○	*
Building Core/Community Forum	◒	◒	○	○	*
Team Suites/Clusters of Classrooms	◒	●	○	◒	***
Great Spaces	●	○	○	○	*
Modified Open Space	○	○	◒	○	**
Supervisable Circulation Paths	●	○	○	●	**
Flexible/Adaptable Learning Facility	●	●	○	●	**
Home as a Template for School	◒	○	○	○	*
Design Diversity	◒	○	○	○	*

Character of Individual Spaces					
Small Classrooms	○	●	●	●	***
Variety of Learning Centers	○	◒	○	◒	**
Well-Defined Activity Areas	○	○	◒	○	**
Table Groups	○	◒	○	◒	**
Nested Classroom Groupings	○	◒	○	○	**
Portfolio Process Studio	○	●	○	○	**
Administration in the Mainstream	○	◒	○	○	*
Cluster of Teacher Offices	◒	●	○	◒	**
Indoor-Outdoor Transition Spaces	◒	○	○	○	**
User-Friendly/Child-Centered Aesthetics and Scale	◒	◒	○	◒	**

Critical Technical Details					
Indoor Climate	●	○	◒	◒	***
Appropriate Acoustics	●	○	◒	●	***
Natural/Full-Spectrum Lighting	●	○	◒	◒	**

Key

Magnitude of Justification

- ● Strong
- ◒ Some
- ○ None
- ◎ Patterns discussed in this paper

Confidence Rating

- *** Very Confident
- ** Moderately Confident
- * Slightly Confident

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professions. In addition, there is a need for a process view of the implementation of these reform ideas, both educationally and architecturally. For instance, the design patterns presented here represent a fraction of the number of patterns which may have arisen from the work of many architects and educational researchers over a span of 30 years which have not been identified. As educational philosophies continue change into the 21st century, many new patterns will arise which have not been suggested by either empirical, educational or architectural literatures.

The implications of this process view further suggest that new design patterns will emerge from the feedback of students, teachers, and administrators in school facilities as they struggle to implement these and other reform ideas. Including students and teachers in the process of identifying design patterns which work will not only increase their environmental awareness of the possible use and management of classroom space, but may further support the spatial and environmental implications of educational reform ideas at a grassroots level..

The critical importance of the physical environment of the school in supporting educational program reforms should not be ignored. The success of the educational reforms of the 1990s will depend, in part, on the support these reform programs receive from the physical setting in which they are placed. [4]

Figure Captions

Figure 1. And the Winning School is ... Smaller. The Public Education Association and others recommend downsizing elementary and middle schools to 500 to 600 students per school, arguing that smaller schools will lead to a more humane educational system.

Figure 2. School as a Community Center/Necklace of Community Activities. The school is rapidly becoming a hub for an ever increasing set of community activities having an impact on the lives of the community and the normal operation of the school. The school is becoming a learning community for child and adult day care, health and other social services, youth programs, town hall meetings, recreation, and even housing. Architecturally, the school may wrap around the community functions as around a "town square," or the community functions may become a "necklace" around the school.

Figure 3. Team Suites/Clusters of Classrooms. A series of small suites of interconnecting, inter-communicating classrooms and support facilities around central core functions in which teachers and students together constitute a small community.

Figure 4. Supervisable Circulation Paths. Balancing the needs for clear circulation that connects all activities in the school with the need for supervision and the avoidance of nooks or crannies where undesirable behaviors could occur.

Figure 5. Small Classrooms. Research indicates that smaller classroom sizes (under 20, even down to 13-17) lead to better learning attitudes, higher achievement scores and higher teacher satisfaction and morale, and afford different and varied instructional practices.

Figure 6. Portfolio Process Studio. The demands for authentic testing require the provision of appropriate space for working on portfolios, and exhibiting them, including but not limited to A/V studio, dance and performance studio, individual project work space, large open project tables, a gallery to display work, and a staging area.

Figure 7. Cluster of Teacher Offices. To support the ideas of shared decision-making, professionalism among teachers, and a community of learning, private teacher offices may be clustered and share a common seminar space, meeting room, and staff back-stage.

Notes

1. The reader is referred to the series of monographs, technical manuals, and papers on child care listed in *Publications in Architecture and Urban Planning Research* and in "Publications and Papers on Children and the Designed Environment" available from the UW-Milwaukee Center for Architecture and Urban Planning Research.

2. For this evidence, see G.T. Moore & J.A. Lackney, "School Buildings and School Performance," *Rethinking Schools*, 1993 (under review).

3. A recent example was at the architectural jury presentation and exhibit of school architecture cosponsored by the American Institute of Architects at the American Association of School Administrators 1993 conference in Orlando. In answer to a question, the chair of the jury remarked that none of the approximately 100 submissions broke new conceptual or educational ground. None reported any connection to the educational research, environment-behavior, or educational reform literatures.

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Submitted April 9, 1993
Word count: 3688 plus captions and notes